PHANTOM HIGH-SPEED CAMERA

T-SERIES **MANUAL**

When it's too fast to see, and too important not to.®

PHANTOM®

ViSiON **RESEARCH**

AMETEK®
MATERIALS ANALYSIS DIVISION

Phantom T-Series Manual

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INTRODUCTION

Phantom T-Series high-speed cameras are available with either a one or four-megapixel resolution sensor, which both have their own unique characteristics and benefits.

- The T1340 4Mpx camera was developed for applications where high resolution is beneficial including microscopy, tracking projectiles and objects far in the distance and for use with imaging techniques for flow visualization and Digital Image Correlation (DIC).

- T3610 / 1Mpx cameras offer higher frame rates and sensitivity due to backside illuminated sensor technology, ideal for ballistics studies and material analysis.

SENSITIVITY, EXPOSURE INDEX AND BINNING

Phantom cameras are available in color or monochrome. While color cameras produce visually dynamic video and additional information, mono cameras are selected when greater light sensitivity is required - often a critical factor due to the low exposure times associated with high-speed imaging.

The Exposure Index (EI) function is available in PCC or using the on-camera controls. EI effectively boosts the ISO beyond the native value by applying pre-defined tone curves. This method preserves the raw image data and overall look of the image throughout the EI Range, which varies by camera model based on the native ISO and recommended settings.

The pixel binning feature boosts sensitivity by grouping pixels into 2X2 blocks to create a larger pixel area. This converts a 4 Mpx sensor to 1 Mpx with 1024 x 976 resolution

that consists of large 27 micron pixels, rather than the T1340's normal 13.5 micron pixels. This results in a frame rate boost at low resolutions. Both monochrome and color cameras support the Binning function, note that the image output is always monochrome with Binning enabled.

CAMERA CONTROL

All Phantom cameras come with PCC software for Ethernet-based setup and control. T-Series cameras also have an **On-Camera Control (OCC)** menu system for use with an attached video monitor. The OCC menu can adjust both basic and advanced settings. Capture, Play and Save-to-CineMag functions are also available.

IMAGE STORAGE

The RAM buffer determines the maximum duration of each high-speed recording. For example, a T3610 with 256 GB RAM can capture 1280 x 800 at 38,040 fps for 4.5 seconds. Memory can be segmented using Multi-Cine to capture several shorter events back-to-back with no downtime between shots.

T-Series cameras can be equipped with a CineMag interface for use with secure, removable Phantom CineMag V media. The CineMag V is available in 2TB and 8TB capacities, and can save a 144 GB Cine in under 3 minutes. CineMags also support direct recording for long record times at reduced resolution and support video playback to review all the recordings.

Data on the CineMag V can be downloaded via a Phantom CineStation IV, or the camera, using 1Gb or 10Gb Ethernet. 10Gb Ethernet is the fastest way to download the files to optimized systems. Cine Raw files are compatible with many of the video industry's top editing and measurement programs, or they can be converted to a variety of formats (e.g. h264.mp4, Apple ProRes.mov, avi and tiff) using PCC software.

IMAGE MONITORING & VIDEO OUTPUTS

Phantom T-Series cameras have a micro HDMI port and 3G HD-SDI outputs for use with video monitors. Standard video rates up to 1080 p60 are supported. These outputs make it easy to use a small on-camera monitor or viewfinder for composing the shot and watching smooth playback immediately, without being tethered to a computer.

The video feed from each output is identical and can show either live video or playback from the camera RAM or CineMag.

ADDITIONAL FEATURES

Programmable I/O: Assign and define signal parameters for each Programmable I/O port. Available signals include Strobe, Ready, F-Sync, Pre-Trigger, Event, Memory Gate and several core signals. See Programmable I/O section for more information.

Data Acquisition: External sensor data imported through a compatible National Instruments DAQ model can be embedded in Cine files and visualized in PCC along with the high-speed images.

Image-Based Auto-Trigger (IBAT): Trigger the camera (or a number of connected cameras) from motion detected within the live image. The active IBAT area and parameters are defined using PCC or the camera's OCC menu interface.

Exposure Tools: Auto-exposure, Threshold mode for the video output, PCC histogram, and a Zebra pattern overlay in PCC are all tools used to dial in the best exposure without over saturation.

Multi-Cine: Support for up to 63 partitions.

Quiet Fans: When enabled, the fans are stopped during capture to eliminate vibration.

**Continuous Recording:** Automatically and continuously saves Cines to external storage.

Shutter Off Mode: (also known as Exposure in PIV) turns off the shutter to maximize achievable exposure with minimal frame overhead.

Burst Mode: Generate a precise number of frames with every frame sync pulse.

P12L: Raw Cine 12-bit linear file packing method that applies to RAM downloads. This is an alternative to the standard Packed-10 (P10) log format used to increase download speed without visible data loss.

DHCP: Dynamic Host Configuration Protocol enables the automatic assignment of an IP address when using a DHCP router. This method eliminates the requirement to define the PC's dedicated camera network. Automatic DHCP is an alternative to the secondary user-definable IP network available in all Phantom cameras.

HV Trigger: High Voltage (HV) trigger, when selected in PCC the camera will trigger from a +6-32V pulse.
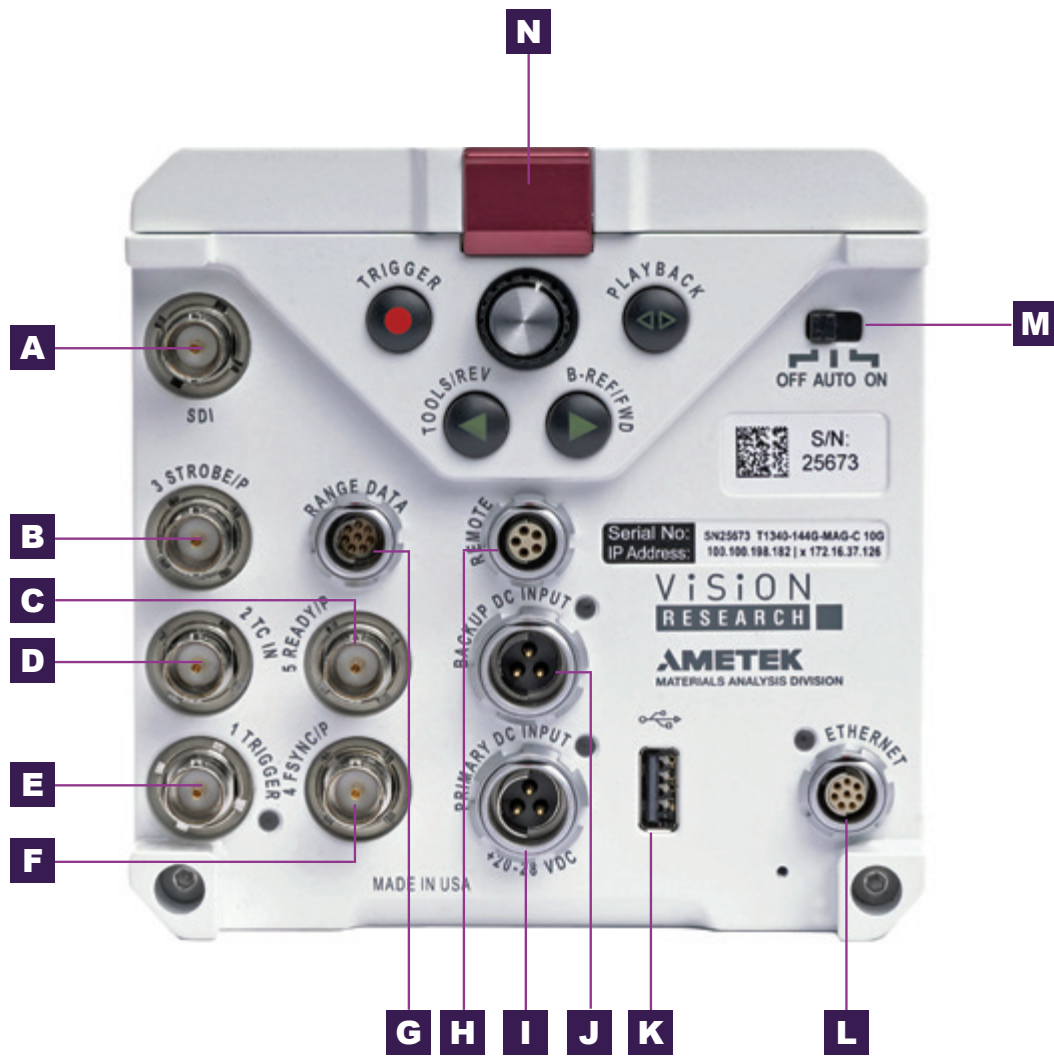
REAR CONNECTOR PANEL

A complete cable connector reference and pin-out guide is available in the last section of this manual.

A SDI — BNC outputs 3G-SDI video

B 3 STROBE /P — Programmable I/O, Port ID = P3. Default signal = Strobe

C 5 READY /P — Programmable I/O, Port ID = P5. Default signal = Ready

D 2 TC IN — Timecode-in fixed port for IRIG-B (Modulated/Unmodulated)

E 1 TRIGGER — Trigger-in fixed port. TTL pulse, Switch closure

F 4 FSYNC /P — Programmable I/O, Port ID = P4. Default signal = FSync

G RANGE DATA — 8-pin Fischer used to input and embed frames with acquisition data

H REMOTE — 5-pin Fischer for RS-232 serial communication

I BACKUP DC INPUT — 3-pin Fischer for 20-28V DC backup power

J PRIMARY DC INPUT — 3-pin Fischer for 20-28V DC primary power

K USB — For WiFi dongle (Dongle requires chipset RT5370)

L ETHERNET — 8-pin Fischer port for Gigabit and 10Gb Ethernet for control and data transfer

M POWER SWITCH — Off/Auto/On functionality (see FAQ)

N CINEMAG PORT — Port under door, exists on CineMag models only

FRONT CONNECTORS

O SDI — Din (mini-BNC) outputs 3G-SDI video

P HDMI — HDMI Type-D* video output. *Cameras to 2021 had HDMI type A port

Q VF PWR — 4-pin Hirose port outputs +12V power for small monitors and viewfinders, rated up to 12W

Phantom cameras are typically controlled with PCC software through a dedicated Ethernet network. PCC is compatible with the 32- and 64-bit versions of Windows 10 operating systems.

The latest version can be downloaded at: *www.phantomhighspeed.com/PCC*

Gb & 10Gb ETHERNET

Phantom T-Series cameras come with standard Gigabit (Gb) Ethernet and have the option to be configured with 10-Gigabit (10Gb) Ethernet as a secondary means of connection. With 10Gb Ethernet, significantly higher download speeds are achieved, providing a great option for saving large files quickly out of RAM.

The camera has one Ethernet port which handles both protocols. The camera will auto-negotiate the connection speed based on the computer's network card and its IP configuration as described later in this section.

First, check to see if the camera has the 10Gb Ethernet option installed by looking at the Serial Number and IP Address label on the back of the camera. If installed, '10G' will be printed on the label, in addition to an 'XIP' address that begins with 172.16 as pictured.

GETTING STARTED
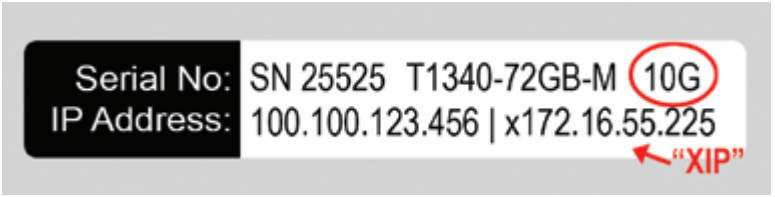
ASSIGNING A Gb CAMERA NETWORK

Connecting the camera using Gb Ethernet simply requires the computer to detect the IP address range of Phantom cameras.

PCC software includes a **Network Configuration Utility** which will launch automatically after the software is first installed, or it can be later launched from the PCC program itself.
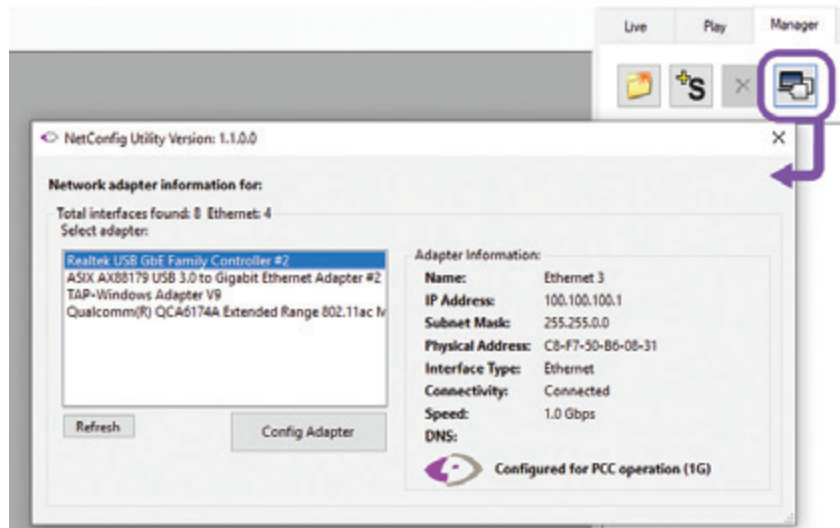
The NetConfig Ultility will show all network interfaces currently installed in the PC.

Identify the one that will be physically connected to the camera (this process can be done with or without a camera connected at the time).

Click '**Config Adapter**', which will then adjust the IP Address and Subnet to the first one available within the 100.100 network that all Phantom cameras are pre-configured to work with. Once connected, the Phantom logo will appear on the lower right with the "Configured for PCC operation" message.

OPTIONAL: MANUALLY ASSIGN Gb CAMERA NETWORK

Alterntatively, In the Windows '**Network and Sharing Center**,' select the camera network. Change the Ethernet IP settings by selecting '**Properties**,' then '**TCP/IPv4**' '**Properties**,' then select '**Use the following IP address**.'

Enter **IP address 100.100.100.1** and **Subnet 255.255.0.0**. Other settings should be blank.

WORKING WITH 10Gb ETHERNET

STEP 1: IDENTIFY NETWORK ADAPTER

Identify a **10GBase-T** network card or adapter for the computer itself. For desktop (tower) PCs, Vision Research specifically recommends Intel **PCIE** cards.

Laptop computers must have a **Thunderbolt** port available in order to use one of the Thunderbolt-10GBase-T converters on the market. At the time of writing, there are two recommended converters: **Promise Sanlink3-N1** Part # SL3N1CL and the adapter by **StarTech** Part # TB310G

STEP 2: INSTALL DEVICE DRIVER

The camera and network adapter, if applicable, should be powered on and connected during the driver installation.

Install the latest device driver from the manufacturer's website, then reboot the PC.

A new, unidentified network should now be available, visible in the **NetConfig utility** or in the Windows '**Network and Sharing Center**.'

STEP 3: INSTALL PCC WITH 10Gb PHANTOM DRIVER

The latest version of PCC software should be installed from the disk that came with the camera or by running setup.exe within the package downloaded from the website.

Click through the prompts, and be careful to click '**YES**' when the program prompts you to install the 10 Gigabit Ethernet Driver. The PCC installer also allows for the Phantom 10G driver to be installed without re-installing PCC.

STEP 4: ASSIGNING A 10Gb CAMERA NETWORK

The camera should be powered on and physically connected to the 10Gb network card or Thunderbolt adapter. The 10Gb Ethernet network needs to be assigned to the 172.16 IP range.

Use the Phantom **NetConfig Utility** as described in the previous section to detect the new network and assign the 10Gb IP address automatically.

Alternatively, In the Windows '**Network and Sharing Center**,' select the camera network. Change the Ethernet IP settings by selecting '**Properties**,' then '**TCP/IPv4**' '**Properties**,' then select '**Use the following IP address**.'

Enter **IP address: 172.16.0** and **Subnet 255.255.0.0**. Other settings should be blank.

> **Important: Ensure no Windows firewall or virus protection are applying to either Phantom Ethernet network connection**

With the Network Setup complete, the following steps will guide you through a simple capture and save process.

POWER ON CAMERA

Connect the camera's dedicated power supply to the Primary DC input, and move the power switch to the ON position. The camera is ready for operation when the red capture light of the Trigger button is illuminated. Note that the camera can take up to 90 seconds to boot.

MOUNT PHANTOM CINEMAG *(OPTIONAL)*

Insert a Phantom CineMag V if applicable. For detailed instructions, see '**Working with Phantom CineMag**' section.

LAUNCH PCC SOFTWARE

Double-click the PCC icon located on the desktop. Camera will be recognized immediately if connected and network settings are correct.

SELECT CAMERA FOR USE

In the '**Manager**' tab, select the Phantom camera to be used from the '**Cameras**' group folder. Click the 'Live' tab.

DEFINE RECORDING PARAMETERS

Click '**Cine Settings**' and define the following parameters by either selecting the value from the pull-down selection list or typing a value into the respective data entry field.

1. Set '**Resolution**' to the required Width x Height.

2. Choose the required '**Sample Rate**,' and '**Exposure Time**'

3. Set '**Post Trigger**' to zero (0) by moving the 'T' (Trigger Position) slider to the right, or enter zero (0) into the '**Last**' data entry field.

Click the '**CSR**' button to perform a Current Session Reference. A CSR is a black reference for that session. It is required before capturing the first cine and after changing any recording parameters.

With color cameras, perform a White Balance by right-clicking an area of the image that is neutral gray or white, as long as it is not 100 percent saturated.

FINE-TUNE SETTINGS

After CSR and White Balance are performed, adjust settings, aperture and/or lighting to get a good exposure. A CSR must be performed after any camera settings are adjusted.

'ARM' CAMERA

Click the '**Capture**' button to start recording to the camera's internal RAM memory buffer.

TRIGGER

At the <u>end</u> of the action, click the '**Trigger**' button at the bottom of the '**Live**' panel, the button on the camera OCC, or provide an external trigger signal (TTL pulse) via the Trigger connector.

PLAYBACK AND EDIT CINE

Click the '**Play**' tab to Scrub through the timeline or use the '**Video Control**' buttons to locate the first image to be saved.

Click the '**Mark-in**' ⬚ button.

Locate the last image of the Cine to be saved and then click the '**Mark-Out**' ⬚ button.

SAVE TO COMPUTER

Click the large '**Save Cine...**' button on the bottom of the '**Play**' panel.

1. Navigate to the folder where you want to save the Cine file.

2. Enter a file name and from the '**Save as Type**', select the '**Cine Raw, .cine**' file format.

3. Click the '**Save**' button to begin downloading the Cine file from the camera.

CONFIRM COMPUTER SAVE

Click the '**Open File**' 📂 button. Navigate to the folder and open the saved Cine file. Review the playback by scrubbing through the file and viewing the playback.

SAVE TO CINEMAG V *(OPTIONAL)*

Click the down-arrow of the '**Save Cine...**' button. Select '**Save RAM Cine to Flash**' (in pop-up window). Click the '**Save**' button.

Confirm '**Flash Cine Save**' before deleting from RAM by selecting and reviewing the new Flash Cine from the top '**Play / Cine**' pull-down list. Flash Cines are indicated with the name '**F#**'.

A TRIGGER

When camera is in capture mode (writing to internal RAM), button glows red. A single tap will trigger the camera. When a Cine is captured, the button glows green.

When in video playback mode, tap the trigger button to exit the menu.

When the menu is active, tap the trigger button to go live.

To clear the RAM recording and re-enter capture mode, hold down trigger button for four seconds.

B MENU

Tap the menu button to activate the camera's menu system as described on the following pages. Turn the knob to navigate through the menu, and tap to select. Exit the menu by waiting 10 seconds or tapping the Trigger button

C PLAYBACK

Tap to enter playback mode when a cine is stored in RAM. Playback buttons will glow green when camera is in playback mode.

D TOOLS

In Live mode, a tap of the Tools button will cycle through video zoom levels (for focus assist) and threshold (exposure assist).

When in playback mode, the play-backward symbol is illuminated and this button is used to play reverse. A long press will do a fast-reverse. Tap to pause.

E B-REF

In live mode, a long press of the B-Ref button will perform a Current Session Reference (CSR).

When in playback mode, the play-forward symbol is illuminated and this button is used to play forward. A long press will do a fast-forward. Tap to pause.

Use of the on-camera control menu requires a video monitor or viewfinder to be connected to the camera.

ON-CAMERA CONTROLS

ON-SCREEN DISPLAY (OSD) OVERVIEW

The On-Screen Display (OSD) provides valuable information about the camera's current status over the video outputs along with the live or playback images.

VIDEO DISPLAY, 'LIVE' MODE

VIDEO DISPLAY, 'PLAYBACK' MODE
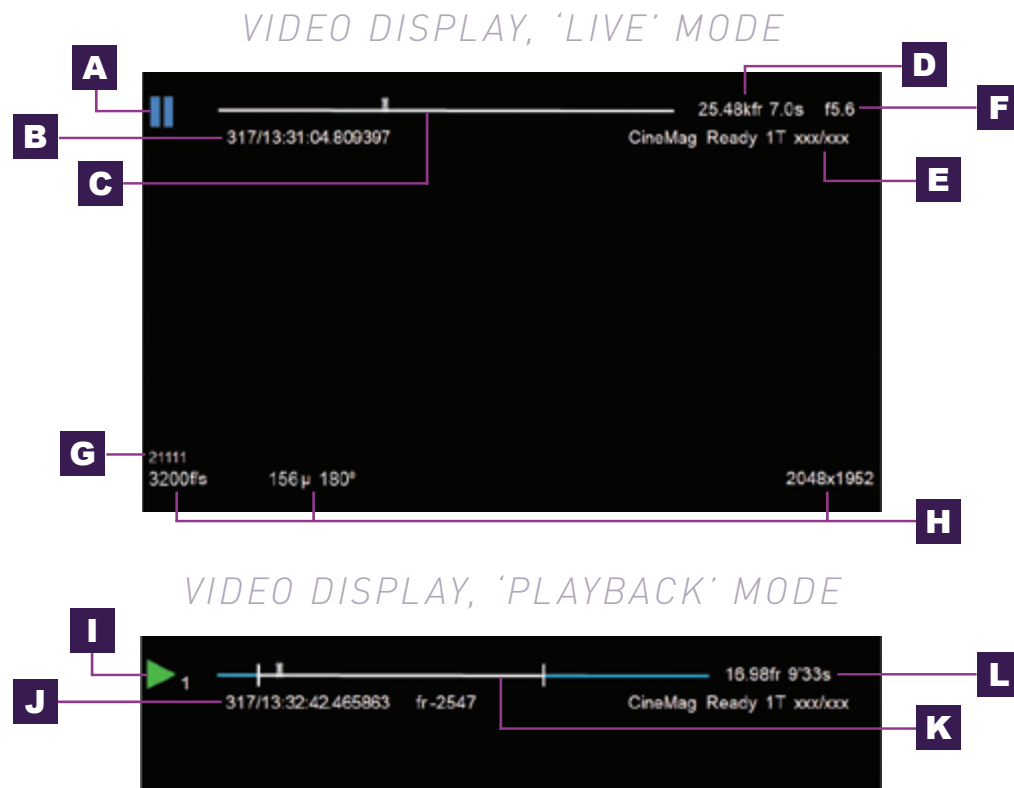
A CAMERA STATE

The symbol changes based on the camera's state:

Live: The camera is not recording and a live image is displayed from all SDI ports.

Capture: The camera is recording to internal memory (RAM) and awaiting a trigger signal.

Triggered: The camera has been triggered and is filling RAM memory ('Post-Trigger' frames).

Cine Stored: Recording has ended and a Cine is stored in RAM memory. The Cine must be erased from the RAM to begin recording again.

Playback: The camera is in 'Playback' mode. RAM Cines can be reviewed, edited and saved to flash.

B TIMECODE

Indicates the IRIG timecode stamped to each frame.

C BUFFER BAR WITH TRIGGER POINT

This 'timeline' represents all frames available in camera RAM ('Loop' mode). The 'T' indicator represents the user-defined trigger point.

D FRAME COUNT & DURATION

Displays the frame count and recording time based on the current camera settings.

E FLASH MEMORY STATUS

Indicates the memory size of the Phantom CineMag (if present) and the total recording time available.

F EF LENS APERTURE DATA

Displays the f-stop (aperture) the lens. Valid for Canon EF mounts only.

G CAMERA NAME

Indicates user-defined camera name. If not defined, the camera serial number is displayed.

H CAPTURE SETTINGS

Shows frame rate, exposure time and resolution.

I CINE INDICATOR

Indicates the Cine number selected for playback.

J PLAYBACK TIMECODE

A visual representation of the Cine timeline with the trigger (T) point, mark-in and mark-out (I) points, and play head indicated.

K PLAYBACK BAR

Shows the timestamp of each frame in IRIG format and the current frame number.

L PLAYBACK

Frame count and playback duration based on current video settings, within the mark-in and mark-out points.

MENU OVERVIEW

The On-Camera Control menu provides access to major camera settings for operation and playback. The menu is activated with a press of the menu knob and displayed as an overlay to the camera's video outputs (SDI and HDMI)

> The menu is subject to change as functionality may be added with future firmware updates.

NAVIGATION

Activate the menu by pressing the 'Menu' knob on the back of the camera. Turn the knob to scroll through each menu item and press to select. The six menu pages can be quickly jumped between by selecting the page title ('1/6 CAMERA' in this example) and scrolling through them.

To exit the menu, tap the 'Trigger' button. The menu will also turn itself off after a period of inactivity.
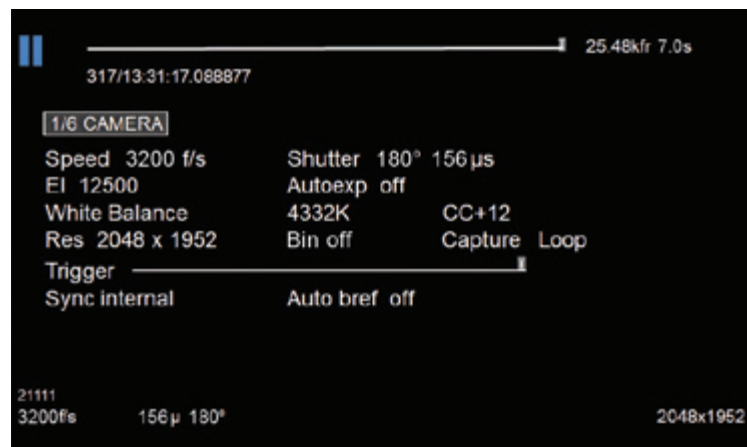
SIX MENU PAGES

1/6 CAMERA
2/6 IMAGE
3/6 SETTINGS
4/6 INFO
5/6 AUTO
6/6 ADVANCED

1/6 CAMERA

The CAMERA menu page includes controls for the fundamental settings.

SPEED

Sets the acquisition frame rate in frames-per-second.

SHUTTER

Sets the exposure time.

EI

Sets the Exposure Index (EI).

AUTOEXPOSURE

Enables autoexposure for changing lighting conditions.

WHITE BALANCE

For color cameras, place a white or neutral gray object in front of the camera. Ensure that the white subject is not fully saturated. Select the phrase 'White Balance' and rotate to select 'OK.'

RESOLUTION

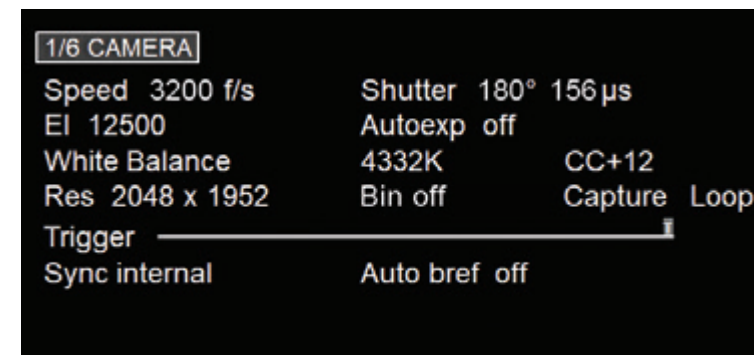Sets the acquisition resolution of the sensor.

TRIGGER

Sets the trigger point. The timeline represents all frames available in RAM.

SYNC

Changes the frame sync (F-Sync) from internal to an external source.

AUTO B-REF

When enabled, a black reference will be automatically performed when the camera enters 'Capture' mode.

MENU SYSTEM

2/6 IMAGE

The IMAGE page allows for control of image processing and video settings. These image settings are adjustments applied to Cine Raw files as metadata.

```
2/6 IMAGE
Master gamma       2.222
Master gain        1.000
Master black       0.000
PA       0 x 0     PAO        0 , 0
Zoom fit           Color Bars   off
Video system       1080/29.97psf
```

MASTER GAMMA

Sets the relationship between the signal level and brightness output of the image.

MASTER GAIN

Adjusts the overall signal level of the image linearly.

MASTER BLACK

Adjusts the baseline black level. The default of 0 should produce images with black at 0 on a waveform monitor.

PA & PAO

The camera adds a Production Area (PA) with the specified frame size as an overlay on the image. PAO is the Production Area Offset, which will move the Production Area from the center of the image both vertically and horizontally. 0, 0 is the default.

ZOOM

Changes the zoom level of the video output.

COLOR BARS

Switches all video outputs to display SMPTE HD color bars.

VIDEO SYSTEM

Sets the video output to one of the valid video systems. The video outputs will change immediately. However, the new video system must be confirmed to take effect.
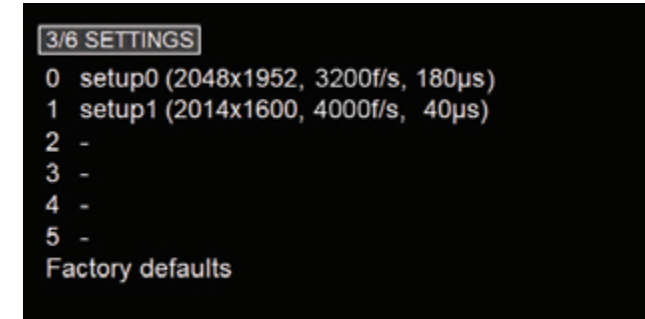
3/6 SETTINGS

The SETTINGS page allows for user setups to be saved and recalled.

```
3/6 SETTINGS
0  setup0 (2048x1952, 3200f/s, 180μs)
1  setup1 (2014x1600, 4000f/s,  40μs)
2  -
3  -
4  -
5  -
Factory defaults
```

0-5

There are six available entries. By selecting one of the slots, users can save or recall that particular setup to quickly change all parameters of the camera at a later date. The values in parentheses are meant as a quick reminder of camera settings.

Please note that all camera settings, including video mode, sync mode, image and advanced settings are included. These settings are saved after the camera powers down.

FACTORY DEFAULTS

Recalls the factory defaults to bring the camera back to the original settings from the last time it left the Vision Research factory. This includes all capture, calibration, image processing and video parameters.

This is an important troubleshooting step.

4/6 INFO

The INFO page displays unique information about the camera, including:

```
4/6 INFO
Model: Phantom T1340 144G  S/N: 21111
Firmware level:  234 (22222, 333333, 444444)
Sensor: 50°  Camera 50°  Fan:22%
Default IP Address: 100.100.180.55
User IP Address:      -:-:-:-
10G IP Address:     172.16.26.82
```

**Model:** name, memory and serial number.

Firmware level

Current Temperature of the Sensor and Camera, and the power of the Fan.

Factory-assigned IP address of the camera.

User-defined IP address (secondary IP) which can be set to '**AUTO**' for DHCP compatibility or used with a defined IP range outside of the Phantom 100.100 network. This is set using Phantom PCC software.

10-Gigabit (10Gb) IP address of the camera as assigned by Vision Research. If this is blank, the 10Gb Ethernet option has not been enabled on this camera.
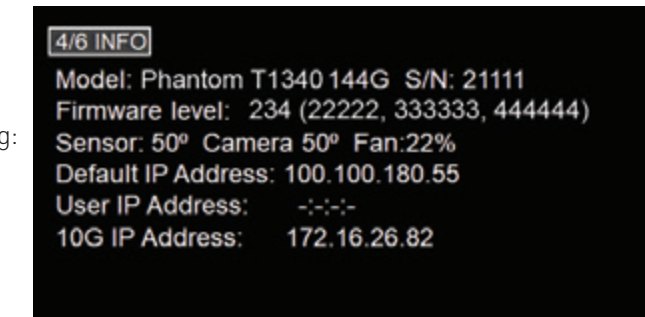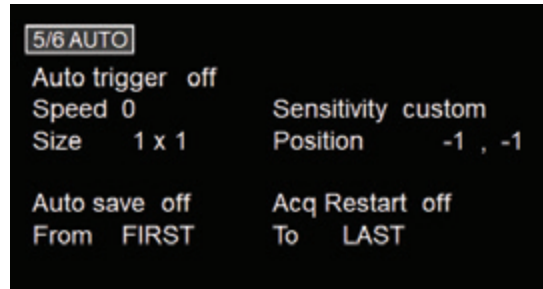
5/6 AUTO

The AUTO menu defines some of the camera's automatic functions.

AUTO TRIGGER

Enables the camera's Image-Based Auto-Trigger (IBAT) function. The settings for Size and Position define the area in which a change in motion will activate the trigger.

AUTO SAVE, FROM & TO

When enabled, the camera automatically saves the Cine, once triggered, to the CineMag. FROM & TO define the first frame and last frame for the auto-save function.

ACQ RESTART

When enabled, the camera automatically starts recording again after the auto-save or auto-play functions are complete.

6/6 ADVANCED

The ADVANCED page includes less-used settings or features which should be used with caution.

RGB GAIN, PEDESTAL AND GAMMA

Sets the Red, Green and Blue channels separately for the Gain, Pedestal and Gamma to fine tune image processing settings.
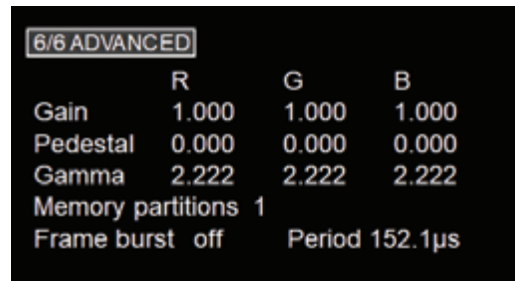
ERASE CINEMAG

Erases the entire contents of an installed Phantom CineMag. A confirmation step is required.

MEMORY PARTITIONS

Sets the number of partitions to segment the RAM for Multi-Cine recording. The RAM is divided evenly.

FRAME BURST & PERIOD

Sets the number of frames in a burst, which are frames that are captured to RAM with every F-Sync pulse. 'Off' disables burst mode. Period sets the interval between the frames in a burst.

CAPTURE A CINE USING THE OCC

Ensure camera is in 'Capture' mode, then Tap the 'Trigger' button to trigger the camera.

With the Cine in RAM, tap the 'Playback' button. The video output will switch to playback view, where you must select the Cine for playback. In the case of Multi-Cine (partitioned) RAM, there will be more than one RAM Cine present.

Once the take is selected, there are options to 'Play,' 'Delete,' 'Delete All' or 'Go Back.' Selecting 'Play' will close the menu and the video will begin to play forward.

Use the 'Play Forward', 'Play Backwards' buttons and the menu knob to scroll through the Cine.

A long press on the forward or reverse buttons will start a fast-forward and fast-reverse playback.
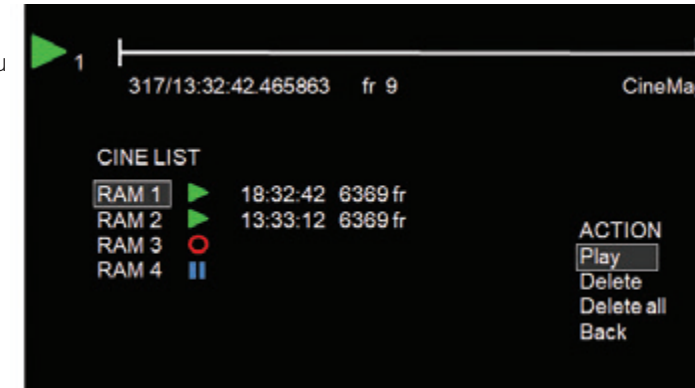
EDIT THE CINE

Tap the menu knob to further edit and save the Cine to an installed CineMag V. An action menu appears with more options.

Use the play arrows or scroll knob to scroll through the Cine.

Set the in-point by selecting 'Set In.' This will be the first frame of the Cine saved to the CineMag. Scroll to the last frame you want to save and select 'Set Out.'

SAVE THE CINE

Select 'Save' to save the Cine to the Phantom CineMag. The OSD will report that the CineMag is saving and provide a countdown. Do not interrupt this saving process.

Once the save is complete, the RAM can be cleared and the camera can go back into 'Capture' mode. The fastest way to do this is to hold down the 'Trigger' button for four seconds.

PLAYBACK & SAVE

PHANTOM CINEMAG V INDICATORS

On the back of the Phantom CineMag are a number of LED indicators that show the current Phantom CineMag status.

MAG CAPACITY INDICATOR

When a Phantom CineMag is empty, all lights will be illuminated. As material is recorded to the mag, the lights will turn off from left to right. The last light will always stay on to indicate power.

ERASE PROTECT SWITCH

When the erase protect switch is in the lock position, the CineMag cannot be erased. Use an appropriate tool, such as a micro-flathead screwdriver, to flip the switch.

ACTIVITY LED

Green for read activity
Red indicates recording
Orange indicates erasing

INTRODUCTION

Phantom T-Series cameras offer a CineMag option, which makes the camera compatible wtih CineMag V recording media. Earlier CineMag IV devices are not supported.

Phantom CineMag is a high-speed solid-state storage module, and differs significantly from a traditional hard drive or solid-state disk in that there is no file system.

For high-speed recording, you must record to the camera's RAM buffer first, review, and then transfer to the CineMag—this is known as '**Loop**' mode. For lower speed recording, the camera can run in '**Run/Stop**' mode, writing direct to the CineMag and allowing several minutes of recording.

It is not possible to delete individual clips from a CineMag because all frames are recorded contiguously. Once the CineMag is full, you can only re-record on it by deleting its entire contents. For this reason, it is recommended that RAM Cines are reviewed and trimmed by setting in and out points prior to transfer from the RAM buffer to the CineMag.

.Cine files are downloaded over Ethernet (either 1Gb or 10Gb) using Windows-based Phantom PCC. The CineMag V can be downloaded from the camera body or CineStation IV.

INSERTING A CINEMAG

The Phantom CineMag slides into the top compartment of the camera and the door latches shut. Ensure the CineMag slides in evenly and mounts securely. CineMag status can be read on the upper right of the video display (OSD).

*PHANTOM CINEMAG V*

SAVING FROM A CINEMAG

Vision Research recommends to download footage from a CineMag in the Cine Raw file format, which preserves all the metadata such as frame rate, shutter speed, timestamps and image processing. Cine Raw is the fastest and best-quality format.

The 10-bit 'Packed' format is the default when saving Cine Raw files. This packing results in smaller, more manageable files than the 'P12L' (Packed 12-bit Linear) or 'Unpacked' formats, and with no visible quality loss.

SAVING AN INDIVIDUAL CINE FROM A CINEMAG

From the 'Play' tab in PCC, select the Cine you want to save from the 'Cine:' pull-down menu. You will see all files in RAM as well as the Flash Cines in the CineMag in this list. Once you've selected a clip, mark an in and out point (if desired) by clicking the ▮ and ▮ buttons respectively. Phantom Video Player (PVP) can be used in a similar manner over video playback.

Then click the green 'Save Cine...' button, choose 'Cine Raw' as the file format, navigate to the folder where you wish to save the clip and click 'Save.'
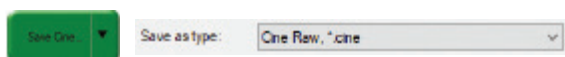

SAVING ALL OR SELECTED CINE FILES FROM A CINEMAG

In the 'Play' tab, click the triangle to the right of the 'Save Cine...' button and, from the pop-up menu, select 'Save All Flash Cines To File.' Or, save only Select Cines with the 'Select & Save Cines to File' option.
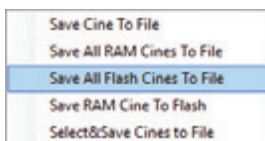
In the save dialog window, navigate to the folder where you wish to save the clips and select the 'Cine Raw' file format. Choose a name for the group of Cine files and click the 'Save' button. Each Cine's file name will start with the name and end with the Cine number.

ERASING A CINEMAG

A CineMag can be erased while installed in the camera using the on-camera control menu or in Phantom PCC and PVP software. In PCC software, navigate to the 'Live → Flash Memory' menu and click the 'Erase' button. Confirm that you wish to delete all clips. In PVP software, tap the 'Erase All' button and confirm.
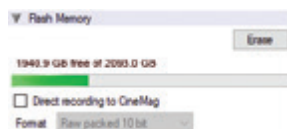
When installed in the CineStation, the CineMag can be erased in the PCC Nucleus program using the Format Flash Memory function.

Erase progress is indicated on the video OSD and by a progress bar in the software. Once complete, all data on the CineMag will be erased and it will be ready for recording again immediately.

ERASE PROTECTION

In order to protect the contents, there is a tiny erase protect switch on the front of the CineMag. When locked, the CineMag can be recorded to but not erased.

PHANTOM CINESTATION IV

The CineStation IV is a simple device meant to quickly and efficiently download the contents of a CineMag V. When connected to a computer running Phantom software, the CineStation behaves almost identically to a camera, except that no capture or live functions will be enabled.

CONNECTING A CINESTATION IV TO PHANTOM SOFTWARE

The CineStation IV comes standard with both 1Gb and 10Gb Ethernet ports. The two ports are independent of each other, but only one can be connected to the software at a time.

The network settings are exactly the same as what is specified for a Phantom camera:

Network IP: 100.100.100.1
Subnet: 255.255.0.0

10Gb Network IP: 172.16.0.1
Subnet: 255.255.0.0

Ensure no firewalls or virus protections are enabled.

PRE-INSTALLATION

Phantom Camera Control (PCC) software operates with Microsoft Windows 10.

The computer and cameras must be associated with the same sub-network to communicate with one another. Typically, the IP address 100.100.100.1 and subnet 255.255.0.0 are defined to the control computer's network card.

When multiple computers are used to control the same camera, each computer requires a unique IP address.
For example, 100.100.100.1 (255.255.0.0), 100.100.100.2 (255.255.0.0), and so on.

PCC SOFTWARE

The latest version of Phantom PCC software can be downloaded from the Vision Research website: **www.phantomhighspeed.com/pcc**
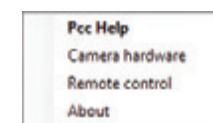
This manual covers the most commonly used functions. See the 'PCC Help' file for details of other settings.
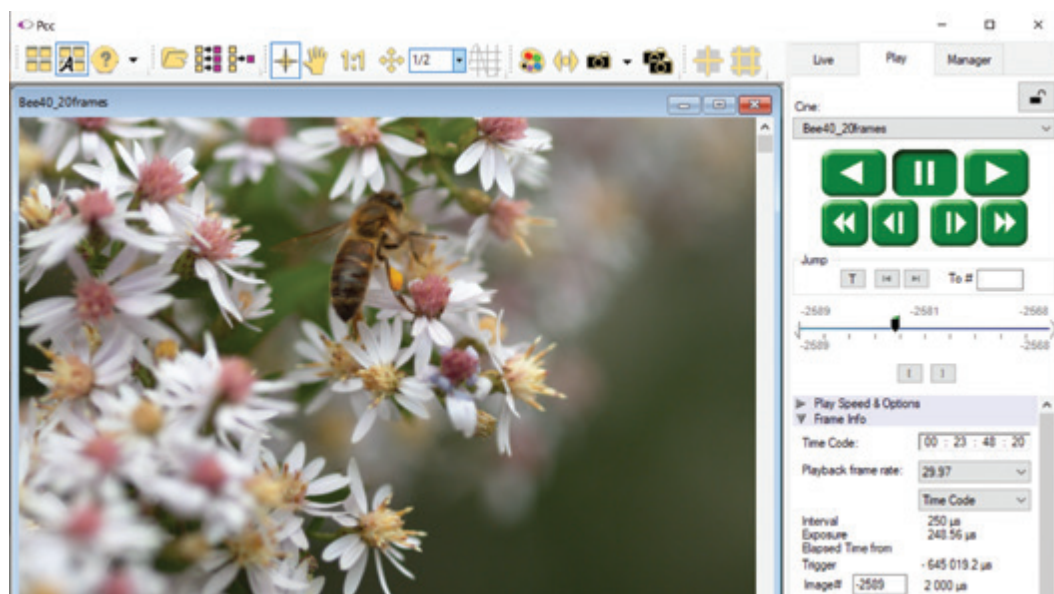
PHANTOM CAMERA CONTROL (PCC) APPLICATION OVERVIEW

TOOLBAR

The '**Toolbar**' buttons provide quick access to the most frequently used functions.
In the program, hover over a button to display a text box briefly describing its function.

The '**Help**' options provide valuable reference information, along with extensive documentation, relating to the software. Online tutorials can be found at *www.phantomhighspeed.com/tutorials.*

CONTROL TABS

PCC provides three control tabs: '**Live**,' '**Play**' and '**Manager**.'

When first started, the '**Manager**' tab is selected. Connected cameras are selected for use and naming in this tab. It is also used to manage saved Cine files.

All camera control and capture parameters (sample rate, exposure time, etc.) are performed in the '**Live**' tab.

Reviewing, editing and saving of Cine files, either from the camera's internal RAM memory, installed Phantom CineMag V or external hard drive, are performed in the '**Play**' tab.
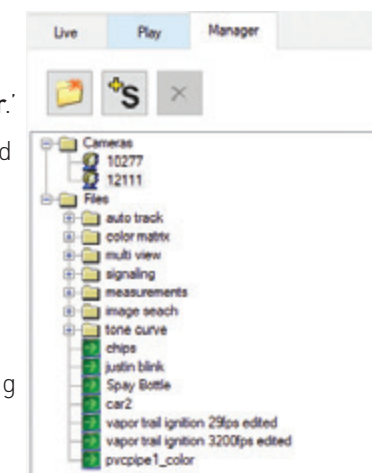
## PHANTOM VIDEO PLAYER (PVP) APPLICATION OVERVIEW

PVP can be launched directly from the desktop shortcut or by the 'Video Out' toolbar button in PCC.

PVP controls the video outputs (SDI and HDMI) connected to a video monitor or viewfinder only.

PVP provides the ability to view, capture, review, edit and/or save a Cine recorded into the camera's RAM, to a hard drive or installed Phantom CineMag. PVP is extremely effective when used with high-resolution cameras since most computers will not play captured raw files smoothly.

The camera's video system and display settings are also set through PVP. The best video system for the project will vary based on the country you are in, what kind of video monitor is used and the required video resolution.

All available video systems for the connected cameras can be found in the 'Settings' menu of PVP, along with production area and other video overlay controls.
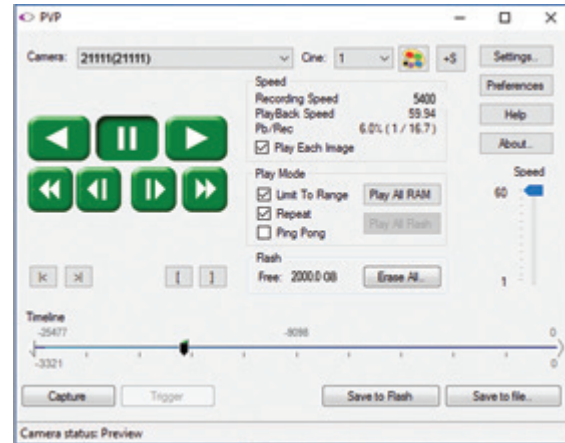
CAMERA CONTROL VIA PCC

PCC provides the ability to select units for specific camera parameters by clicking the 'Preferences' button at the bottom of the 'Manager' tab.

Units can be set to commonly used values ('Presets') or can be customized using the pull-down selection lists. First time users should use one of the three 'Presets.'

The 'Exp' unit is probably the most important unit to be set. It specifies what unit to use when setting the exposure time. The other units to set are EDR (Extreme Dynamic Range, not compatible on all models) and PTF (Post Trigger Frames) covered later in this section.
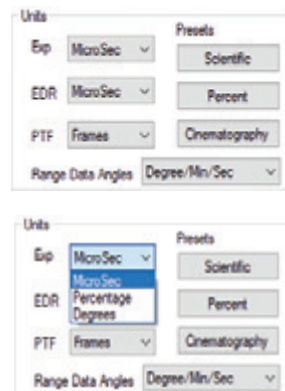
SELECTING A CAMERA

Select the camera(s) to be controlled listed in the 'Manager' tab, or select the camera(s) from the 'Camera' pull-down list in the 'Live' tab.

Once a camera is selected, a 'Preview' panel will display to the left of the control tabs showing the current image being captured by the camera.

IMAGE PROCESSING

'Image Tools' provides extensive control over the look of the image, from color and contrast settings to image orientation and crop settings. The menu is accessed by clicking on the 'Image Tools' toolbar button (the one that looks like an artist's palette).

The top of the 'Image Tools' window displays a 'Histogram.' This is a graphic representation of the pixel brightness levels of the displayed image. The left represents black, the right represents white and the height represents the proportionate number of pixels at that particular value. Unlike a waveform, the histogram's shape is not representative of the content—it is simply an averaging of the brightness values.

Below the histogram are controls which change image settings of the live images, recorded images and the video output.

Some of the variables include; brightness, gain, gamma, saturation, toe, white balance adjustments (Temp (K) and Tint), individual red, green and blue pedestal, gain and gamma values and tone curves.

At the bottom of the window is a 'Default' button that restores all parameters except white balance, tone and color matrix to their default values.

The 'Default White Balance' button restores white balance to the defaults on color cameras.

The Tone 'Reset' button restores the image tone to the default values, and the Color Matrix 'Restore' button returns the color matrix values to their default values.
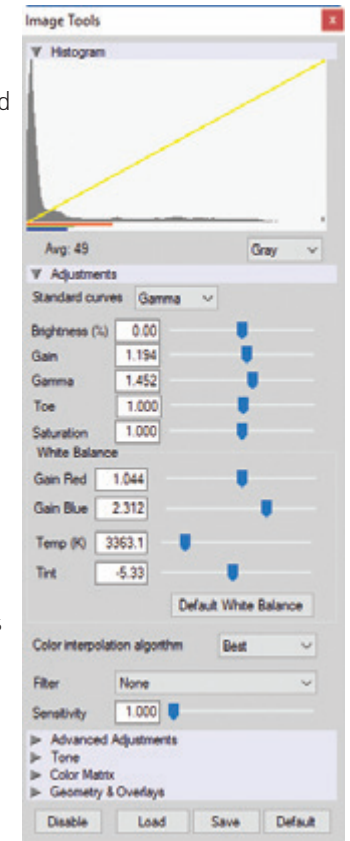
> Changes made here only affect the metadata of the Cine Raw file. They are applied in software but not "baked in."
>
> Image Processing settings are no longer editable after saving to a format other than Cine Raw, so it is important to ensure they are set to values that produce the best looking image.

IMAGE DISPLAY

The 'Zoom Actual Size' toolbar button resizes the images being displayed in the 'Preview/Playback' panel to their actual size.

The 'Zoom Fit' toolbar button resizes the images to fit the panel. Images can also be zoomed to a specific magnification ratio by selecting a number from the pull-down list to the right of the 'Zoom Fit' button.

WHITE BALANCE (COLOR CAMERAS)

Performing a 'White Balance' should be the first step in color adjustment. White Balance not applicable to monochrome cameras.

Right click on an area that resembles white or neutral area in the image, then click on the 'White Balance' pop-up window. It is not necessary to fill the frame with white—a small target can be used.

It is recommended to perform the White Balance after a CSR and on a white or gray object that is not fully saturated.

CAPTURE SETUP: CAMERA & CINE SETTINGS

Set Time: Synchronizes the timestamps embedded in the recorded image data to the computer's clock.

Bit Depth: Most Phantom cameras operate in 12-bit mode only.

Partitions: Select the number of desired partitions (evenly divided memory segments) from the 'Partitions' pull-down menu. For basic camera setups, this should be set to one.

Lens Control: Available for Canon EF lenses only, for control of aperture and focus.

Backup & Restore: Allows for user and factory settings to be saved and recalled from the camera's memory.

Resolution: Sets the camera's acquisition resolution. There are several options in the pull-down menu. Alternatively, type in a value and the closest valid resolution will be set.

Sample Rate: Sets the acquisition frame rate in frames-per-second (fps).

Exposure Time (shutter): Sets the exposure time in degrees, microseconds or percentage (this depends on how the PCC preferences are set).

Exposure Index: Sets the exposure index (Effective ISO) of the image by loading preset tone curves. Adjusting gamma, gain and other settings will contribute to the overall EI value, and this combined value is what should be used to determine lighting.

CSR (Current Session Reference): Closes the camera's internal shutter and resets the black point of every pixel for optimal image quality.

Image Range and Trigger Position: The slider represents the memory buffer, with the 'Duration' indicated in seconds and the total number of frames available.

The trigger position is indicated in the 'Last' pull-down menu and as the 'T' slider along the timeline. The trigger position is exactly when the trigger signal will be detected in the Cine.

KEY ADVANCED SETTINGS

The "Start/End of Recording Actions" section provides options of actions that can automatically be performed at the start or end of each shot, including:

- **Auto save to CineMag/Built-in Flash:** This feature saves a user-specified portion of a clip to the Phantom CineMag immediately after recording.

- **Auto play Video Out:** Begins playback after recording. The range marked under 'Auto play Video Out' affects both playback and saving to the Phantom CineMag.

- **Restart Recording:** When enabled, automatically restarts the recording process after the 'Auto' actions have been performed.
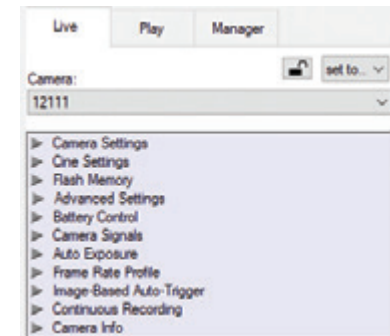
'**External Sync**' instructs the camera to use one of the following options:

- **Internal:** Camera uses its internal crystal oscillator to drive the frame rate.

- **External:** Camera uses externally supplied frame sync clock pulse to drive the frame rate. This can be used to synchronize two cameras together via F-Sync.

- **IRIG:** Camera uses an IRIG-B signal is supplied to drive the frame rate.

- **Lock to Video:** Frame rate is driven by the camera's current video rate. Fps will jump to the closest multiple of the current video rate (23.98, 24, 25, 29.97 or 30).

- **Sync to Trigger:** Instructs the camera to adjust its frame clock, upon detection of a trigger signal, to ensure all post trigger frames occur at the same moment in time from trigger when repetitive tests are required.

> **When using External Sync it is important to limit the top frame rate by ~1% to ensure the sync period is larger than 1/max_frame_rate + 0.1% or 200ns (whichever is larger), to account for frequency tolerance and jitter.**

FLASH MEMORY

Specifies the camera's operation mode in relation to CineMag recording: '**Loop**' (record to RAM first) or '**R/S**' (bypass RAM and record directly to CineMag). It also displays the amount of free space and size (in Gigabytes) of the Phantom CineMag.
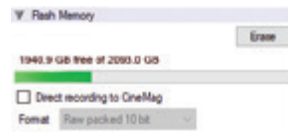
RECORDING A CINE

To begin recording to the camera's RAM click the red '**Capture**' button.

The red '**Capture**' button changes to '**Abort Recording**' and the green '**Trigger**' button is enabled when the camera is recording. The '**Abort Recording**' button instructs the camera to stop recording, leaving the camera's RAM empty.

TRIGGERING THE CAMERA

Selecting the '**Trigger**' button instructs the camera to immediately stop recording when the '**Trigger Position**' is set to zero. If a value greater than zero is set, the camera will continue to record '**post-trigger**' frames until the user-specified value is met.

> **Using the camera's external trigger signal provides a more accurate trigger to the camera. This is also referred to as a '**hardware trigger.**'**

For direct recording to a CineMag, set '**R/S**' (Run/Stop) mode by selecting the '**Direct Recording to CineMag**' box in the '**Flash Memory**' section. Start recording by clicking the red '**Record**' button. Once the camera is recording directly to the Phantom CineMag, the 'Record' button changes to a '**Stop Recording**' button.

REVIEWING A CINE

Once the camera has completed recording a Cine in the camera's RAM or CineMag, it can be reviewed by selecting it from the '**Cine**' pull-down selection list in the PCC '**Play**' tab.

A previously saved Cine stored on the computer's hard drive can be opened using the '**Open File**' 📂 toolbar button. (When used, it also places the file under the '**Cines**' group folder in the '**Manager**' tab.)
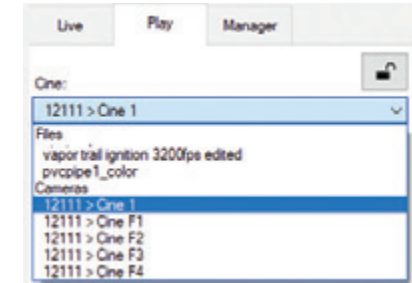
Use the '**Video Control**' buttons to review the Cine:

|	
A	REVERSE PLAY
B	PAUSE
C	PLAY
D	FAST REVERSE
E	REVERSE 1-FRAME
F	ADVANCE 1-FRAME
G	FAST FORWARD
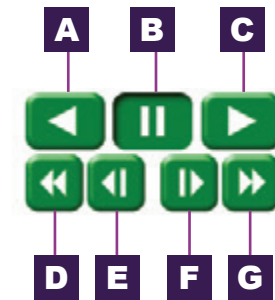
PERFORMING A QUICK SEARCH THROUGH A CINE

Quickly find the points of interest:

'**Scroll**' (scrub) through the clip using the slider or click anywhere on the timeline to jump to that point quickly.

'**Jump**' to the trigger frame by clicking on the '**T**' button, or jump to specific frames by entering the frame number into the jump '**#**' data entry field, then hit the enter key.

'**Image Search**.' The goal is to search or find an image change in the recording, based on the differences between image content. Right-click on the '**Play**' button to begin the image search. Besides image content changes, '**Image Search**' can also look for images that are tagged as '**Event**' images.
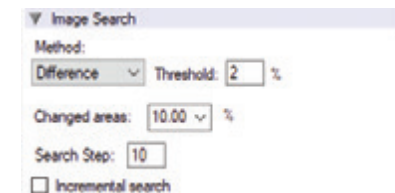
EDITING AND SAVING A CINE

Using the following 'Video Control' buttons, locate the first image of the Cine to be saved and click the 'Mark-In' 『I』 button. Locate the last image of the Cine to be saved and click the 'Mark-Out' 『I』 button.

Click 'Play, Speed & Option' and enable (check) 'Limit to Range.'

Under the 'Video Control' buttons, click the play button and review the edited Cine.

Click the 'Save Cine...' button to save the edited Cine to the computer's hard drive.

If you wish to save the clip to an attached Phantom CineMag, click the down arrow to the right of the 'Save Cine...' button and select 'Save RAM Cine to Flash.'

WORKING WITH CINE FILES

The images recorded on the camera's RAM or Phantom CineMag are stored in a Vision Research proprietary RAW (uncompressed) file structure called a 'Cine' file.

These Cine files can be converted to industry standard formats (ProRes, H264, DPX, DNG, TIFF, JPEG and more) with PCC software provided by Vision Research.

Phantom PCC and PVP software are compatible with Windows operating systems. There are third party solutions available for working with Phantom cameras in Mac OS X.

COMPATIBILITY WITH VIDEO EDITING PROGRAMS

Several popular video editing programs, such as DaVinci Resolve, have incorporated the Phantom Cine Raw file format into their software. This means Cine files do not have to be converted and no additional software is required.

Please test the footage with the program you choose before committing, as updates to the program or Cine file format can sometimes break compatibility. For this reason, it is important to know how to properly convert Cine Raw files using PCC.

CONVERTING CINE RAW FILES

Single Cine files can be converted by selecting the desired format from the 'Save as Type' selection list in the 'Save Cine' dialogue window.

The file formats above the separator line in the 'Save as Type' selection list are 'movie-

like' formats (meaning the entire clip will be saved as a single file), while the formats below the line are image formats (meaning each frame of Cine will be saved as a sequence of images).

To convert a Cine to a 'movie-like' format, select the desired format from the list, navigate to the destination folder, assign a file name to the clip and save.

Some valuable parameters can be found in the 'Advanced Settings' window, such as the particular codec.

Other formats, like .avi and .mp4, allow the compression ratio to be entered. The lowest compression is the default.

CONVERTING TO A SERIES OR STACK OF IMAGES

Beginning with PCC software version 3.5, the autoname functionality eliminates the need to add a special character to create a sequence of images. Use one of the presets in the save dialogue. Vision Research also recommends setting a project name, in the 'Auto-name settings' menu found in the top bar pull-down arrow next to the snapshot functions.
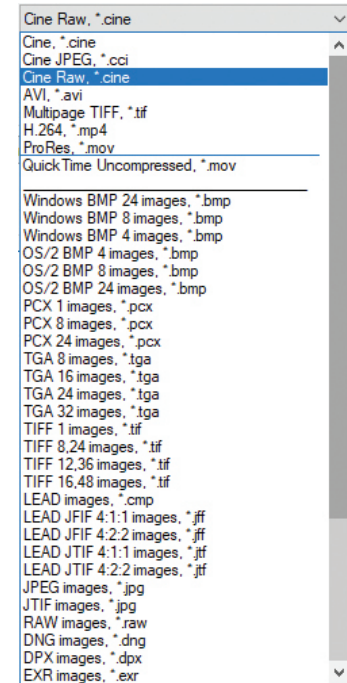
BATCH CONVERT
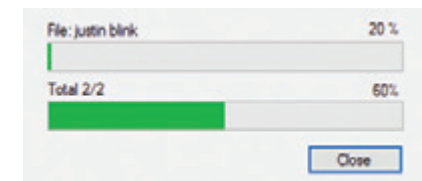
The 'Batch Convert Files' toolbar button can be used to convert a single saved Cine file, or multiple saved Cine files, into any one of the supported file formats.

Use the shift and/or control keys to select the Cine files you wish to convert in the 'Open Cine' dialogue window, then click the 'Open' button.

Navigate to the destination folder in the 'Multifile Convert Destination' dialogue window and select the file format.

PCC creates a separate folder for each Cine file, assigns the original file name and appends the appropriate image number and extension to each image.

Once the 'Convert' button is clicked, a progress window appears for the duration of the conversion process. Each converted Cine will be placed in its own folder named after the original Cine file.

> Re-saving a clip in the Cine Raw format can be useful for creating sub-clips with no loss in image quality or metadata.

T-SERIES SIGNAL ASSIGNMENTS	
Port 1	Trigger (fixed)
Port 2	Timecode-in (fixed)
Port 3 (P3)	Prog I/O-Default Strobe
Port 4 (P4)	Prog I/O-Default F-Sync
Port 5 (P5)	Prog I/O-Default Ready

INTRODUCTION TO SIGNALS

Phantom cameras incorporate multiple hardware signals to interface to external devices. These are used to drive the camera's frame rate, shutter and trigger, to output to other devices, to monitor with an oscilloscope, and to import test sensor data using a Data Acquisition (DAQ) unit.

Ports on Phantom cameras are either fixed, assignable or programmable. Assignable ports are typically labeled '**Aux**' on the connector, and the '**Camera Signals**' menu in PCC is used to select between the 2-3 signals that can be assigned to that port.

Programmable I/O incorporates a pulse processor. In addition to assigning different signals, the signal characteristics can be modified to better interface with external devices. In most cases, the signal polarity, filter time, delay, pulse width and edge (rising versus falling) can be set. Setting these characteristics is referred to as '**Pulse Processor Control**.'

Programmable I/O ports can be identified on the camera body with a '**/P**.' Each port is to be identified in the PCC '**Camera Signals**' menu using the port number. Each one has a default which will be set after a factory reset or by using the '**signal default**' function in PCC.

TRIGGER SIGNAL

Phantom cameras by default accept a contact closure or a 5V TTL pulse for the **hardware trigger** to the camera.

T-Series cameras are also compatible with a **High Voltage (HV) trigger** between 6-32V. Select between standard and HV in the PCC signals menu for P1, where Falling Edge (default), Rising Edge, Trigger Delay and Filter Time settings can also be defined.

PROGRAMMABLE I/O

PCC INTERFACE

The 'Camera Signals' menu, located in the 'Live' tab, provides access to and control over these Programmable I/O signals.

A summary of the current signal settings can be found under the pull-down menu associated with each port. By clicking 'Default All,' PCC will reassign the factory-assigned defaults for the Programmable I/O signals.

PULSE PROCESSOR CONTROL

After selecting the signal assignment, further configuration is possible by clicking the gear symbol next to each port. The 'Pulse Control' menu is opened, as shown on the next page.

A graphic representation of the signal behavior is also displayed. However, this is **not to scale** and should be used as reference only. Use of this feature requires an oscilloscope to truly visualize the signals and the subsequent changes with each adjustment.
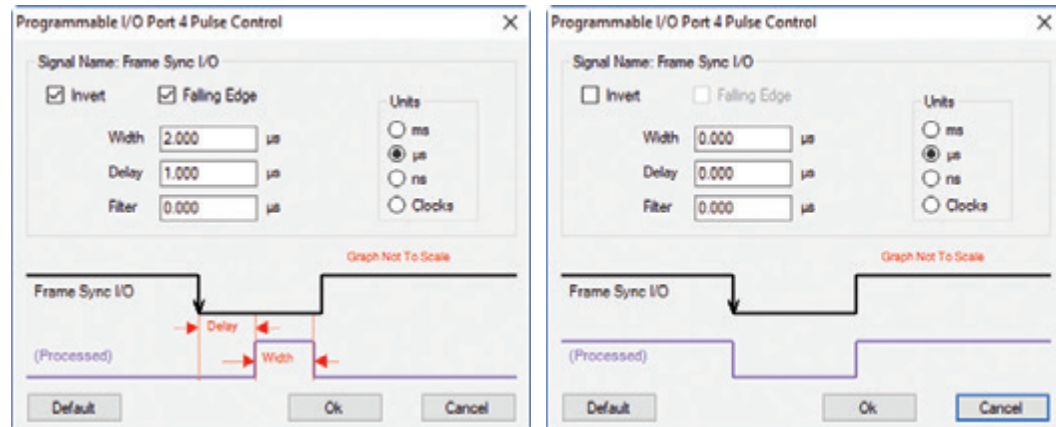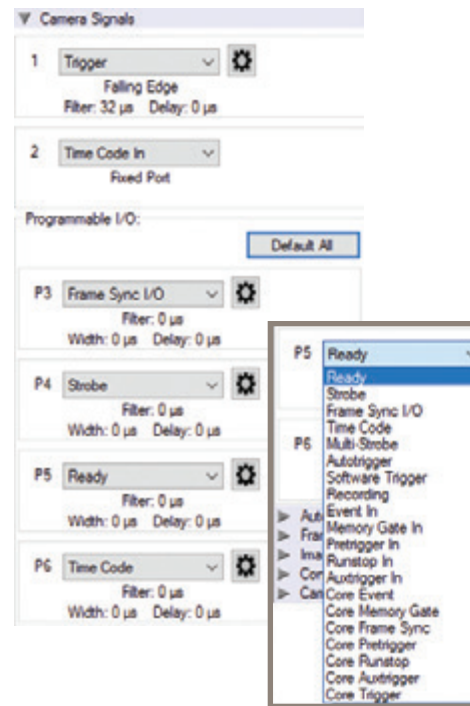
Input: *When a signal is generated by the camera, it serves as an input to the 'pulse processor.' In this context, the term 'input' does not represent an externally generated signal.*

SUMMARY OF PULSE PROCESSOR SETTINGS

Invert: Inverts the signal at the output of the pulse processor.

Falling: Selects 'Falling Edge' mode for the pulse processor. This mode is only relevant if the 'Width' is also specified. When the 'Falling' token is present together with 'Width,' the pulse processor will generate a negative pulse, triggered from the negative edge of the input signal.

Width (Pulse Width): When a 'Width' token is present, a defined-length pulse is generated, which starts after the specified 'Delay' and after the active edge of the 'input' signal. The length of the pulse is specified in microseconds (as a floating point number) and internally converted to pixel clock units. The maximum pulse width is at least 10 seconds. However, if the period of the 'input' signal is lower than the selected width, the latter is dynamically clamped to the signal period. The minimum pulse width is one pixel clock.

Delay: Delays the output pulse by the specified time in ms, μs or camera clock multiples. If the 'Width' token is not present, both edges of the signal are delayed by the same amount. If present, the delay is measured from the rising edge of the input* signal unless the 'Falling' token is present, in which case the delay is measured from the falling edge of the input. The delay time is specified in microseconds and is internally converted to pixel clock units.

Filter (Filter Time): When a 'Filter' token is present, the 'input' of the pulse processor is filtered through an edge filter of the specified time. The time of the filter can be between 0 and 1 second. In order for the output of the filter to be asserted, the 'input' signal must be continuously de-asserted for the same duration. The edges of the 'input' are thus delayed by the specified filter time (for a 'clean' input pulse). Filtering is applied before and independently of the delay and duration. The filter time is specified in microseconds and is internally routed to pixel clock units.

> **Pixel Clock:** The period of the pixel clock is the basic time interval for all camera timing.

Please note that pulse processors can sometimes generate pulses too short for the output drivers to switch and the processed signal should be verified with an oscilloscope before use.

PROGRAMMABLE SIGNALS & DESCRIPTIONS

The settings as described are the signal's default state prior to processing.

Ready: An isolated open collector output with 1k pull-up signal (active high). 'Ready' is asserted when the camera goes into 'Capture' mode and is de-asserted either when the Cine is triggered or when recording is completed. 'Ready' changes synchronously with frame capture (at the end of each exposure), so in 'External Sync' mode it will not change until F-Sync pulses are received.

Strobe: An isolated open collector output signal with 1k pull-up. When asserted (low) 'Strobe' indicates that the electronic shutter is open. Strobe is low for the duration of the exposure.

F-Sync: The only signal can be set as an output or input. By default, it is output (sync-internal). Output signal is a frame sync pulse from the camera's frame rate generator. A short (few

hundred ns depending on camera model) negative pulse with the falling edge is used as timing reference. Input signal is active on falling edge. (Default state is high.)

TC-Out: A positive polarity time code signal. Normally an unmodulated (dc-shifted) IRIG-B (at RS-232 levels) which follows the internal time base of the camera. It is recommended not to process the 'TC-Out,' since a processed signal will not represent an accurate time code.

Auto-Trigger: Used to output a hardware trigger signal or pulse with the duration.

Software Trigger: An active high-output signal (pulse) generated as a result of the trigger protocol command.

Recording: An active high-output signal indicating active recording into a RAM partition.

Event In: If the input is sampled low at the end of an exposure, an 'E' (Event) bit in the frame's timestamp is set.

Memory Gate In: If the input is sampled low at the end of an exposure, the corresponding frame is skipped from storage to RAM.

Pre-trigger: An active low-input (default high) signal. Keeping this signal low for enough time (10—500 ms or until 'Ready' signal goes high) will make the camera start recording, if it has an available RAM partition.

Aux Trigger: An input signal active on the rising edge (default high). An alternative trigger input that can be processed through the pulse processor and assigned to different ports.

THE CORE SIGNALS

Core signals are copies of externally generated signals, routed through the camera and output to assigned ports. Unless indicated otherwise, feedback is taken after any pulse processor for the input. Core signals can be pulse-processed before being output.

Core Event: Feedback output from the 'Event In' signal.

Core Memory Gate: Feedback output from the 'Memory Gate In' signal.

Core Frame Sync: Feedback output from the 'F-Sync In' signal. The feedback is taken after any pulse processor for the output, but before the delay element.

Core Pre-trigger: Feedback output from the 'Pre-trigger' signal.

Core Aux Trigger: Feedback output from the 'Aux Trigger In' signal.

Core Trigger: Feedback output from the main 'Trigger' input. The feedback is taken before the trigger signal is affected by the trigger polarity, filter or delay settings. 'Core Trigger' can be used like the 'Trigger Out' signal.

LENS MOUNTS

The default lens mount on a Phantom T-Series camera is a Nikon F-mount and many additional mounts are available. When ordering a second mount with the camera purchase, this one will be installed when the camera ships from Vision Research unless otherwise specified. These are the available lens mounts:

NIKON F-MOUNT

The Nikon mount is compatible with manual aperture lenses and G-style lenses. A mechanical lever on the front of the mount allows for manual adjustment of the aperture on G-style lenses.

CANON EF-MOUNT

The Canon mount works with electronic EOS lenses and allows for remote software based control of aperture and focus on compatible lenses. T-Series cameras use the same Canon mount as the Flex4K, part # **VRI-MNT-F4K-EOS**

PL-MOUNT

A PL mount may be required for certain large, heavy lenses and to take advantage of unique Cine-style lens options. These cameras use the same PL mount as the VEO4K, part # **VRI-MNT-VEO4K-PL**

C-MOUNT AND M42 MOUNT

A threaded C-mount or 'Universal' M42 lens mount may be required for specialized optics, such as microscopes for scientific imaging or rugged lenses for harsh test applications. These are specific to the T-Series camera, part #s **VRI-MNT-TSERIES-C; VRI-MNT-TSERIES-M42**
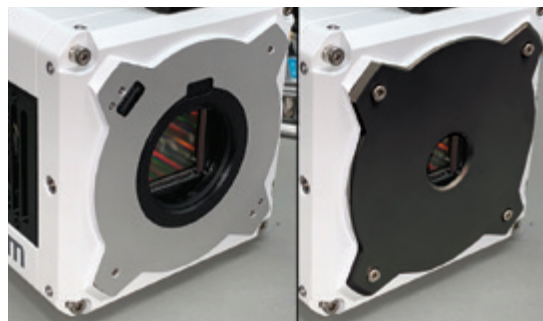
INSTALLING A LENS MOUNT

Installing the lens mount is easy. For the Nikon, Canon and PL options, remove the four M4 socket screws that are attaching the current lens mount. Ensure all shims that are behind the mount are transferred to the new mount and are attached using the same screws.

To install the threaded C or M42 mount, the adapter ring behind the Nikon Canon or PL mount gets removed instead. This adapter is attached using four M3 screws.

Front with F-mount removed

Front with mount adapter ring removed (left) and C-mount installed (right)

Ensure all electronic components in the adapter and Canon lens mount are protected when installing or storing these items.

> Any time the lens mount is removed, it's important to verify the back focus. A proper backfocus ensures the lens will focus at infinity, and stay in focus throughout its zoom range. A set of extra lens mount shims is included with every lens mount in order to adjust the camera's back focus when necessary.

CASE WITH CUSTOM FOAM

A Pelican 1510 case with custom foam, specific to T-Series cameras, is available. The case features wheels and a handle and is a convenient size for shipping or transportation. The foam accommodates the camera body, a full set of cables, a small lens or monitor and camera manual. Part # **VRI-CASE-TSERIES**

Case with camera, lens and basic cable set included

SIDE MOUNTING BRACKET

When the sensor resolution is windowed vertically, the frame rates are increased more than they would be when windowed horizontally. This results in a horizontal aspect ratio, which is ideal for objects that move side-to-side. However, for objects that move vertically it may be beneficial to mount the camera on its side. The T-Series mounting bracket provides four stable, centered mounting points while ensuring proper airflow. Part # **VRI-TSERIES-SIDEMNT**

Note that the distance from mounting surface to optical center is not identical to the base when using the T-Series side mount.

Camera with side-mounting bracket installed

VIEWFINDER & MONITOR OPTIONS

Viewfinders and monitors are available from third party sources, and are connected to the camera's front SDI, HDMI and 4-pin Hirose VF Power port. These ports support small low power monitors up to one amp. Larger devices must be powered from a separate source.

Vision Research sells a compatible on-camera monitor kit that includes a TVLogic 5.5" OLED monitor, VF power cable and top camera mount, part # **VRI-TVLOGIC-MONITOR-055A-VF**.

Additional 0.5m VF PWR cables for alternative monitors and viewfinders are available that allow connection to an XLR4, a 2-pin Lemo or DC21 input.

WiFi ADAPTER FOR USB PORT

Wireless functionality exists with a USB WiFi adapter attached to the camera's USB port. The USB adapter must support 802.11 protocol and it must have an RT5370 chipset for compatibility. Vision Research sells a compatible adapter with part# **VRI-USB-WIFI**.
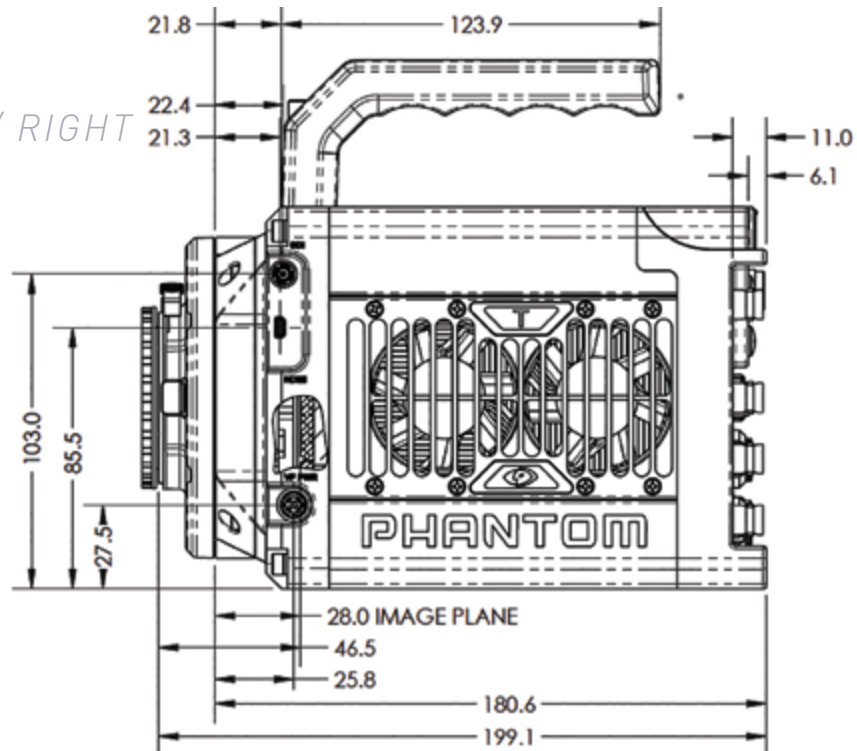
Ensure the adapter is installed when the camera boots up. Once connected, the WiFi Network will be visible as the camera name. The password for the connection is: 'CameraConnect'

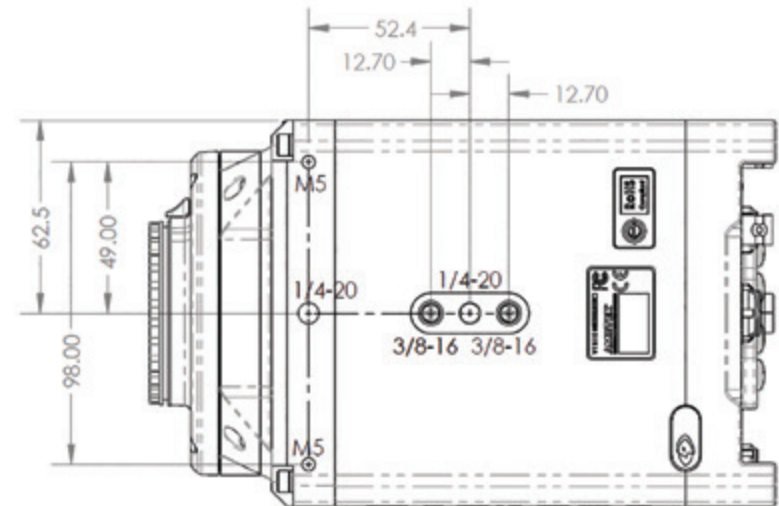## BATTERIES AND BACKUP POWER
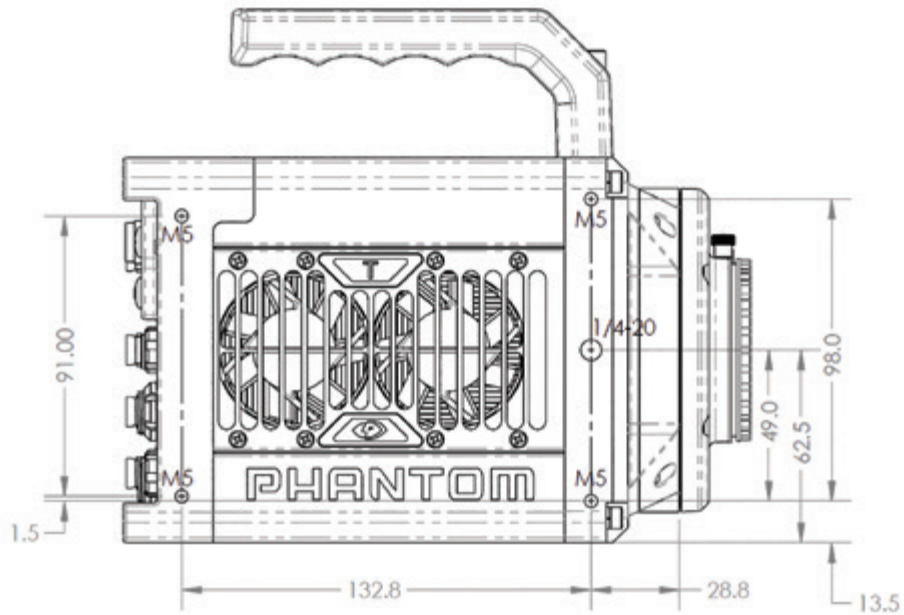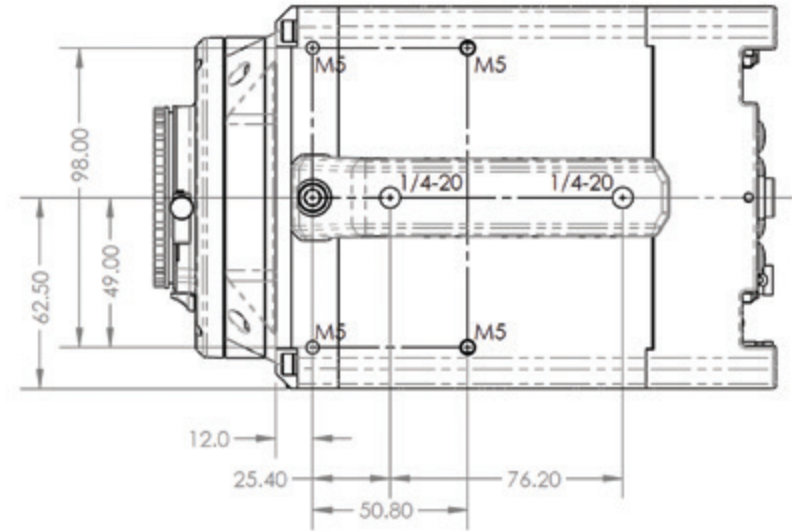
The battery or backup power source must be able to output in the 20-28V range and supply at least 8 Amps. The camera consumes maximum 150W with CineMag.

The camera ships with an XLR3 cable extension for power, which can be used with 24V battery sources including 3rd party power station solutions that combine 2 or more 14.4V batteries.

MECHANICAL DRAWINGS

LEFT / RIGHT

TOP / BOTTOM

PHANTOM T-SERIES BNC CONNECTORS

BNC

NOMENCLATURE/FUNCTION	
1 Trigger	Dedicated I/O - Trigger-In / active-low isolated input. Can be activated by a switch to ground. The trigger pulse needs to be at least three microseconds long.
2 TC In	Dedicated I/O - Timecode In / can accept IRIG-B and SMPTE standards.
Program-mable I/O	Programmable I/O ports have a +5V maximum threshold, input is also compatible with TTL levels and must be properly terminated (50-ohms). Isolated collector output with 1k pull-up.
SDI	75-ohms. Outputs standard HD-SDI signals up to 1080 p60

ETHERNET CONNECTOR (FEMALE)

Cable 8-pin Fischer Part #SS 103 A058-130

PIN	WIRE	NOMENCLATURE/FUNCTION
1	Blue/White	MDI2P Media Dependent 2 Positive
2	Blue	MDI2N Media Dependent 2 Negative
3	Brown/White	MDI3P Media Dependent 3Positive
4	Brown	MDI3N Media Dependent 3 Negative
5	Green/White	ETHRXP Ethernet Receive Positive
6	Green	ETHRXN Ethernet Receive Negative
7	Orange/White	ETHTXP Ethernet Transmit Positive
8	Orange	ETHTXN Ethernet Transmit Negative

POWER CONNECTOR (MALE) (PRIMARY & BACKUP)

Cable 3-pin Fischer Part #SS 104Z040-80

PIN	NOMENCLATURE/FUNCTION
1	+20–28VDC
2	CHGND / Chassis Ground
3	GND / Power Ground

VF PWR CONNECTOR (FEMALE)

Cable 4 pin Hirose part # HR10A-7P-4P

PIN	NOMENCLATURE/FUNCTION
1	GND Chassis Ground
2	RTALLY Red Tally
3	GTALLY Green Tally
4	+12 VDC / up to 1 Amp

CONNECTOR PIN-OUTS

RANGE DATA CONNECTOR (MALE)

Cable 8-pin Fischer Part #S-103-Z-058-130

PIN	NOMENCLATURE/FUNCTION
1	GND / Power Ground
2	ROUT+ / Remote/Range Data Out (Positive), (RS-422); +5V maximum. 5Mbps; 60m max distance
3	ROUT- / Remote/Range Data Out (Negative), (RS-422); +5V maximum. 5Mbps; 60m max distance
4	RIN+ / Remote/Range Data In (Positive), (RS-422); +5V maximum. 5Mbps; 60m max distance
5	RIN- / Remote/Range Data In (Negative), (RS-422); +5V maximum. 5Mbps; 60m max distance
6	+3V3R
7	+24VR
8	GND / Power Ground

REMOTE CONNECTOR (FEMALE)

Cable 5-pin Fischer Part # S-103-A-054-130

PIN	NOMENCLATURE/FUNCTION
1	+24VDC output
2	PNG / The power and the acquisition control signals are isolated from the camera system ground. This isolation is designed to avoid system ground loops only and should not be subjected to high voltages.
3	XRXD / Receive Data (RS-232); +5V maximum, normally limited to 50 feet (16 meters).
4	XTXD / Transmit Data (RS-232); +5V maximum, normally limited to 50 feet (16 meters).
5	IOGND2 / RS232 Ground - All the serial ports are not isolated (referred to system ground). They should only be connected to properly grounded equipment.

These cameras can have a lot of memory! How long does it take to save a shot?

Phantom T-series cameras are available with 10Gb Ethernet and the unique Phantom CineMag interface for fast downloading. 10Gb Ethernet allows data transfer at up to 500 MB/second on optimized systems, which means all 144 GB of memory can be downloaded in approximately 4 minutes.

Typically, the entire high-speed RAM buffer is not saved at once - the Cine is first reviewed while in RAM, mark-in and mark-out points are set, and then the shorter Cine raw file gets saved accordingly. One common workflow is using Multi-Cine to segment RAM, then record several shots with no delay. Once any or all segments are full they can be reviewed and then the best captures can be saved. Because these shorter files do not take up the full RAM buffer the download time becomes much faster.

The CineMag interface also speeds up the download time out of RAM. A CineMag is fast, non-volatile, flash memory that transfers footage at rates up to 1.4 Gpx/s. An 8TB CineMag V will save the entire unedited 144 GB Cine file in under 2 minutes.

Once a shot is saved to the CineMag, it is safely stored and available for later retrieval using a camera or CineStation IV. This means you can immediately use the camera for another shot.

How does one best take advantage of the 10Gb Ethernet interface?

When the 10Gb Ethernet option is installed, the Fischer Ethernet port handles both Gigabit and 10Gb Ethernet protocols. The camera auto-negotiates the connection based on the computer's network card and IP configuration.

When properly configured, 10Gb Ethernet allows for Cine downloads at speeds four to five times that of the Gb Ethernet interface. The speed of the storage drive is key to the overall download speed. Fast NVMe SSD storage drives are required for maximum performance.

A laptop can be used with a Thunderbolt to 10Gb Ethernet converter, such as the Promise Sanlink SL3N1CL and StarTech TB310G. Whether a PCIe card or Thunderbolt converter are being used, Vision Research recommends devices with Intel processors to ensure compatibility.

A CAT6A cable gives you a maximum 100 meter distance between the camera and the interface card. CAT5e and CAT6 cables can also be used up to 30 meters.

FAQS

I see there are two power input ports. How do these work?

The Primary DC Input is where you plug the power supply provided with the camera. You can optionally connect a backup source of power, often a battery, to the secondary backup input.

With the backup power connected, if there is a loss of power on the primary input, the backup power will immediately take over. This protects images stored in the camera's high-speed memory from accidental loss.

When the power switch is set to AUTO, there is no drain from the connected battery unless a loss of primary power causes the power input to switch to the backup source. See next FAQ for more information on this.

In case of primary power loss, the backup battery port will not only protect images saved in memory, but can provide sufficient power to power all camera operations until the input voltage drops below the minimum required, ~20VDC.

If primary power is restored, that becomes the power source for the camera and the battery port reverts to backup mode.

How does the AUTO/ON/OFF switch work?

When a 20-28V power source is connected to the Backup DC only, and the switch is set to AUTO, the camera WILL NOT power up. Connect power to the Primary DC input and the camera will power up. In this situation, if there is a loss of primary power, then the backup power will be used to maintain camera operation and protect any stored data.

AUTO is required when a camera is positioned in a hard-to-reach location and requires a battery backup. This allows for the primary power to be switched on remotely without drain on the battery until the event of an actual primary power loss.

When the switch is moved to the ON position, the camera will power up whether a 20-28V source is connected to the Primary or Backup DC inputs, or both. When both are connected the camera always uses the Primary source first before switching to the backup in the event of a power loss, or if it is a battery dropping below 20V.

ON is typically the better position when using batteries for primary power, as it will allow them to be switched out without interruption.

Which Phantom power supplies work with T-Series cameras?

The camera ships with a 280 Watt power supply (PSU) and 3-pin XLR to Fischer cable for power. This is the same PSU that is used with Flex4K and UHS (vXX12/40) series cameras. Note that early T1340 cameras shipped with a 160W PSU, however Vision Research switched this to a 280W to be consistent across the T-Series product family.

Do T-Series cameras support the use of Canon EOS lenses with software control for aperture and focus?

Yes, an optional Canon EOS lens mount is required, part #VRI-MNT-TSERIES-EOS. Vision Research can only guarantee compatibility with the lenses listed on the tested Canon lens compatibility list, which can be found in a FAQ on the *phantomhighspeed.com* website.

Can the camera be positioned vertically?

Yes, it can when using the side-mounting bracket designed specifically for T-Series cameras. Sometimes vertical framing will be beneficial, as it allows for higher frame rates requiring the full width of the sensor instead of the full height.

It is important to not rest the camera on its side and block the fan compartment, as constant airflow is required during normal operation. The vertical mounting bracket adds two 1/4x20 and 3/8" mounting points to the side, while raising the camera to ensure proper clearance below the fans.

Note that the distance from mounting surface to optical center is not identical to the base when using the T-Series side mount.

Part # for the side mounting bracket: VRI-TSERIES-SIDEMNT

Restoring the factory defaults

If the camera is stuck in an unusual state it may be useful to restore the camera's factory defaults. This returns the capture parameters, image processing, video modes and image calibration back to the original settings.

Factory Defaults can be set in the Nucleus program within PCC, or via the 'Settings' menu of the OCC. Select 'Factory Defaults' / 'OK'. It will take approximately 20 seconds for the camera to return to an operational state.

Is there an Optical Low Pass Filter for the T1340?

An Optical Low Pass Filter (OLPF) is an added filter that goes in front of the sensor, meant to reduce aliasing caused by the bayer pattern of color CMOS sensors, typically with a pixel size of 10 microns or less. It is a feature often found in cameras used for cinema applications.

There is no OLPF option for the T-Series cameras. An OLPF is not universal, it is not possible to use the OLPF designed for a different camera model (like Flex4K) as it will have no positive effect on the image.

CONTACT SUPPORT

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For answers to most questions, please visit us at: *www.phantomhighspeed.com* and search the camera product pages, tutorials, support knowledgebase and FAQs.

SUBMITTING A SUPPORT TICKET

For technical product support, operation and application information or to request an RMA, please submit a ticket by filling out a form at *www.phantomhighspeed-service. force.com* or by emailing us at **phantom-support@ametek.com.**

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REGULATORY

Phantom T1340 **CE - 2020**
Phantom T3610 **CE - 2021**

CE Emissions	CE Compliant - EN 61326-1, Class A
CE Immunity	CE Compliant - EN 61326-1, Class A
FCC	CFR 47, Part 15, Subpart B & ICES-003 Class A
Safety	IEC 60950-1

T1340: R-R-VRi-T1340
KC Emissions KN32, KC Immunity KN35

T3610: R-R-VRi-T3610
KC Emissions KS C 9832; Immunity KS C 9835

Country of Origin: USA

Class A device (Broadcasting Communication Device for Office Use): This device obtained EMC registration for office use (Class A), and may be used in places other than home.

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